PERMIT ATTACHMENT 11
GROUNDWATER MONITORING QUALITY ASSURANCE PROJECT PLAN AND SAMPLING PROTOCOL

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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TERMS

AEA	*Atomic Energy Act of 1954*
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQA	Data Quality Assessment
DQI	Data Quality Indicator
DUA	Data Usability Assessment
DUP	Duplicate (Laboratory)
DWMU	Dangerous Waste Management Unit
EB	Equipment Blank
ECO	Environmental Compliance Officer
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FSO	Field Sampling Operations
FTB	Full Trip Blank
FWS	Field Work Supervisor
FXR	Field Transfer Blank
HEIS	Hanford Environmental Information System
IATA	International Air Transport Association
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MB	Method Blank
MS	Matrix Spike
MSD	Matrix Spike Duplicate
QA	Quality Assurance
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RCRA	*Resource Conservation And Recovery Act of 1976*
SMR	Sample Management And Reporting
SUR	Surrogate
Tri-Party Agreement Action Plan	*Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology Et Al., 1989b)
VOC	Volatile Organic Compound

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11. INTRODUCTION

This attachment contains the quality assurance (QA) project plan (QAPjP) and sampling protocol for the groundwater monitoring programs in this Permit. Section 11.A contains the QAPjP and Section 11.B contains the sampling protocol.

11.A Quality Assurance Project Plan

A QAPjP establishes the quality program for environmental data collection. This QAPjP includes planning, implementation, and assessment of sampling tasks, field measurements, laboratory analysis, and data review. This chapter describes the applicable environmental data collection QA elements for final status groundwater monitoring plans. This QAPjP is intended to supplement Hanford Site QA requirements and the contractor's environmental QA program plan by supplementing DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Document*, which satisfies the Ecology et al., 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan* (hereinafter called the Tri-Party Agreement Action Plan), which invokes EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*.

This QAPjP is divided into the following three sections that describe the quality requirements and controls applicable to the dangerous waste management unit (DWMU) groundwater monitoring activities:

- Section 11.A.1, Project Management.
- Section 11.A.2, Data Generation and Acquisition.
- Section 11.A.3, Data Usability Assessment.

11.A.1 Project Management

This section addresses the management approaches planned, project goals, and planned documentation.

11.A.1.1 Project/Task Organization

Project organization (regarding groundwater monitoring) is described in the following sections and illustrated in Figure 11-1. Titles used in the project organization are for the purposes of discussing the role of the individual in the performance of the work scope. Individuals with different titles but similar/equivalent positions may fulfill these roles.

11.A.1.1.1 United States Department of Energy Manager

Hanford Site operation is the responsibility of the U.S. Department of Energy (DOE). The DOE Manager is responsible for authorizing the contractor to perform activities at the Hanford Site under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); *Resource Conservation and Recovery Act of 1976* (RCRA); *Atomic Energy Act of 1954* (AEA); and Ecology et al., 1989a, *Hanford Federal Facility Agreement and Consent Order*.

11.A.1.1.2 United States Department of Energy Project Lead

The DOE Project Lead is responsible for providing day-to-day oversight of the contractor's performance of the work scope, working with the contractor to identify and work through issues, and providing technical input to DOE management.

11.A.1.1.3 United States Department of Energy Prime Contractor Management

The DOE Prime Contractor Management provides oversight and coordinates with DOE in support of sampling and reporting activities. The DOE Prime Contractor Management also provides support to the Prime Contractor Project Manager so work is performed safely and cost effectively.

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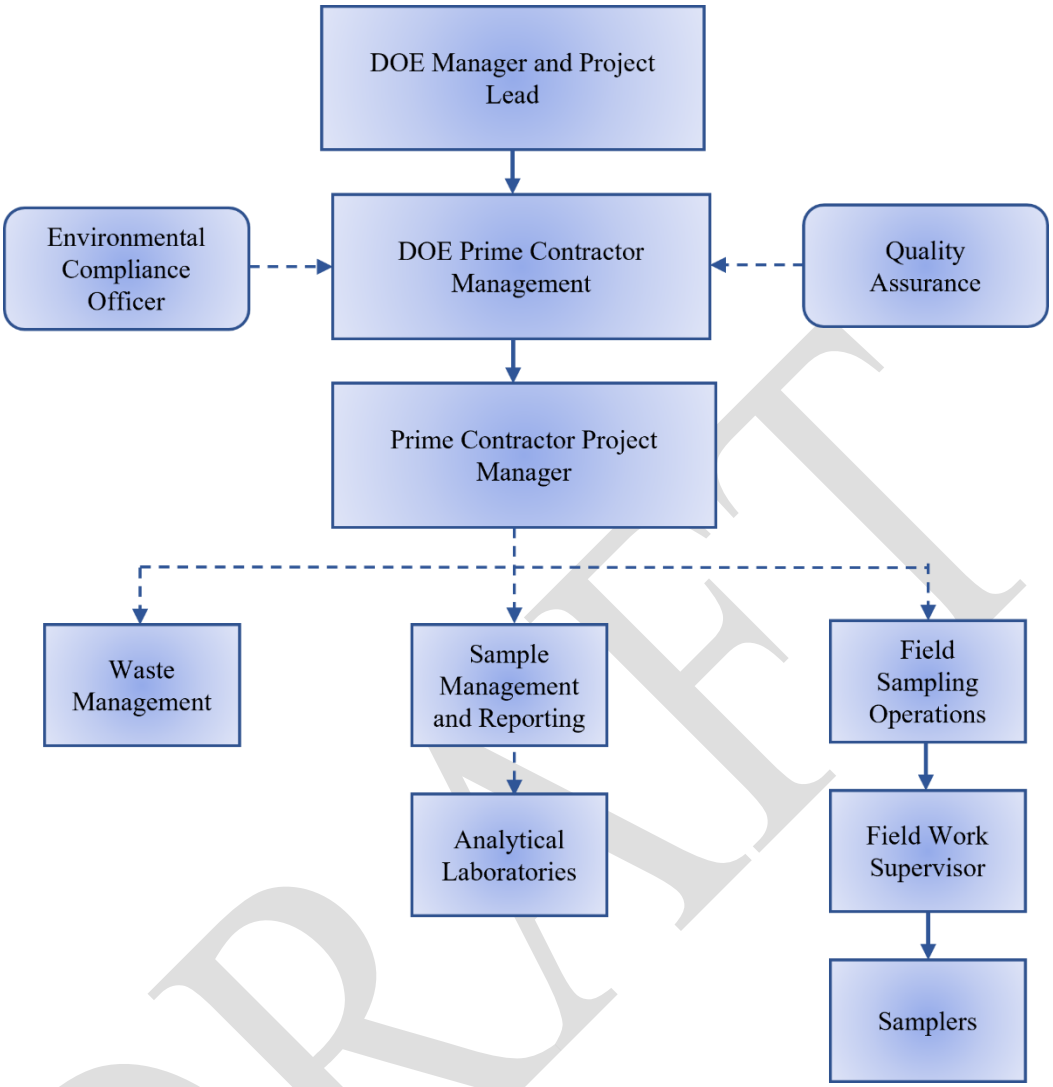

Figure 11-1 Project Organization

11.A.1.1.4 Prime Contractor Project Manager

The Prime Contractor Project Manager is responsible for direct management of activities performed to meet DWMU groundwater monitoring requirements. The Prime Contractor Project Manager coordinates with and reports to DOE and DOE Prime Contractor Management regarding DWMU groundwater monitoring requirements. The Prime Contractor Project Manager (or designee) works closely with the Environmental Compliance Officer (ECO), QA, and Sample Management and Reporting (SMR) group to integrate these and other technical disciplines in planning and implementing the work scope. The Prime Contractor Project Manager assigns staff to provide technical expertise.

11.A.1.1.5 Sample Management and Reporting Group

The SMR group oversees off-site analytical laboratories, coordinates laboratory analytical work with the final status groundwater monitoring plans that utilize this QAPjP, and verifies that laboratories are qualified for performing Hanford Site analytical work. The SMR group generates field sampling paperwork, labels, and instructions for field sampling personnel and develop sample authorization forms that provide information and instruction to the analytical laboratories. The SMR group revises field sampling paperwork to reflect approved changes. This group's responsibilities include receiving

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analytical data from the laboratories, performing data entry into the Hanford Environmental Information System (HEIS) database, and arranging for data validation and recordkeeping. The SMR group is responsible for resolving sample documentation deficiencies or issues associated with Field Sampling Operations (FSO), laboratories, or other entities. The SMR group is responsible for informing the Prime Contractor Project Manager (or designee) of any issues reported by the analytical laboratories.

11.A.1.1.6 Field Sampling Operations

FSO is responsible for planning and coordinating field sampling resources and provides the Field Work Supervisor (FWS) for routine groundwater sampling operations. The FWS directs the samplers who collect groundwater samples for final status groundwater monitoring plans. Samplers collect samples, complete field logbooks, data forms, and chain-of-custody forms, including any shipping paperwork, and assist sample delivery to the analytical laboratory.

11.A.1.1.7 Quality Assurance

The QA point of contact provides independent oversight, is responsible for addressing QA issues on the project, and oversees implementation of the project QA program.

11.A.1.1.8 Environmental Compliance Officer

ECOs provide technical oversight, direction, and acceptance of project and subcontracted environmental work, with the goal of minimizing adverse environmental impacts.

11.A.1.1.9 Waste Management

Waste Management identifies waste management sampling/characterization activities for regulatory compliance and is responsible for data interpretation to determine waste designations and profiles. Waste Management communicates policies and practices for project compliance for waste storage, transportation, disposal, and tracking in a safe and cost-effective manner.

11.A.1.1.10 Analytical Laboratories

The laboratories maintain custody and analyze samples in accordance with established quality systems and provide data packages containing sample and quality control (QC) results. As requested, laboratories provide explanations of results to support data review and resolve analytical issues. Laboratories are accredited by the Washington State Department of Ecology (Ecology) for the analyses performed under final status groundwater monitoring plans and this QAPjP.

11.A.1.2 Problem Definition/Background

The purpose of final status groundwater monitoring plans is to satisfy groundwater monitoring requirements of Part II, Permit Condition II.F, of WA7890008967, Hanford Facility Dangerous Waste Permit (Site-wide Permit), which specify monitoring under Washington Administrative Code (WAC) 173-303-645, Dangerous Waste Regulations, *Releases from regulated units*, for final status DWMUs. Additional information on the activities to satisfy regulatory requirements and background information on DWMU-specific monitoring is provided in the groundwater monitoring plan associated with a given DWMU.

11.A.1.3 Project/Task Description

The focus of final status groundwater monitoring plans is to provide for monitoring in accordance with WAC 173-303-645, evaluate the well network, and interpret analytical results. The constituents and parameters to be monitored, along with the monitoring wells and frequency of sampling, are provided in the groundwater monitoring plan associated with a given DWMU. Information about the collection and analyses of groundwater from the monitoring network is provided in this attachment and in Section 11.B.

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11.A.1.4 Quality Assurance Objectives and Criteria

The QA objective of final status monitoring plans is the generation of analytical data of known and appropriate quality. In support of this objective, the process to assess data usability may include data verification, data validation, or a data quality indicator (DQI) evaluation. Principal DQIs (precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity) are defined for the purposes of this document in Table 11-1.

The applicable QC guidelines, DQI acceptance criteria, and levels of effort for assessing data quality are dictated by the intended use of the data and associated with the analytical method. The process to assess data usability is further discussed in Section 11.A.3.

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Table 11-1 Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Possible Corrective Actions
Precision (field duplicates, laboratory control sample duplicates, laboratory sample duplicates, and matrix spike duplicates)	Precision measures the agreement among a set of replicate measurements. Field precision is assessed through the collection and analysis of field duplicates. Analytical precision is estimated by duplicate/ replicate analyses, usually on laboratory control samples, spiked samples, and/or field samples. The most commonly used estimates of precision are the relative standard deviation and, when only two samples are available, the relative percent difference.	Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory. Acquire replicate field samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.	If duplicate data do not meet objective: • Evaluate apparent cause (e.g., sample heterogeneity). • Request reanalysis or remeasurement. • Qualify the data before use.
Accuracy (laboratory control samples, matrix spikes, and surrogates)	Accuracy is the closeness of a measured result to an accepted reference value. Accuracy is usually measured as a percent recovery. QC analyses used to measure accuracy include laboratory control samples, spiked samples, and surrogates.	Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample).	If recovery does not meet objective: • Qualify the data before use. • Request reanalysis or remeasurement. • Determine if follow-up evaluation is needed. • Evaluate instrumentation and recalibrate, if necessary.
Representativeness (field duplicates)	Sample representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. It is dependent on the proper design of the sampling program and will be satisfied by ensuring that the approved plans were followed during sampling and analysis.	Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied.	If results are not representative of the system sampled: • Identify the reason for the results not being representative. • Flag for further review. • Review data for usability. • If data are usable, qualify the data for limited use and define the portion of the system that the data represent. • If data are not usable, flag as appropriate.

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Table 11-1 Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Possible Corrective Actions
			• Redefine sampling and measurement requirements and protocols. • Resample and reanalyze, as appropriate.
Comparability (field duplicate, field splits, laboratory control samples, laboratory control sample duplicates, matrix spikes, and matrix spike duplicates)	Comparability expresses the degree of confidence with which one dataset can be compared to another. It is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the approved plans are followed and that proper sampling and analysis techniques are applied. Further, when assessing comparability, datasets should be of known and documented quality.	Use identical or similar sample collection and handling methods, sample preparation and analytical methods, holding times, and QA protocols.	If data are not comparable to other datasets: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Qualify the data as appropriate. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future comparability.
Completeness (no QC element; addressed in data usability assessment)	Completeness is a measure of the amount of valid data collected compared to the amount of data planned. Measurements are considered valid if they are unqualified or qualified as estimated data during validation. Field completeness is a measure of the number of samples collected versus the number of samples planned. Laboratory completeness is a measure of the number of valid measurements compared to the total number of measurements planned.	Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project's quality criteria (data quality objectives or performance/ acceptance criteria).	If dataset does not meet the completeness objective: • Identify appropriate changes to data collection and/or analysis methods. • Identify quantifiable bias, if applicable. • Resample and/or reanalyze if needed. • Revise sampling/analysis protocols to ensure future completeness.

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Table 11-1 Data Quality Indicators

Data Quality Indicator (QC Element)[a]	Definition	Determination Methodologies	Possible Corrective Actions
Bias (equipment blanks, field transfer blanks,[b] full trip blanks, laboratory control samples, matrix spikes, and method blanks)	Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., the sample measurement is consistently lower than the sample's true value). Bias can be introduced during sampling, analysis, and data evaluation. Analytical bias refers to deviation in one direction (i.e., high, low, or unknown) of the measured value from a known spiked amount.	Sampling bias may be revealed by analysis of replicate samples. Analytical bias may be assessed by comparing a measured value in a sample of known concentration to an accepted reference value or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike).	For sampling bias: • Properly select and use sampling tools. • Institute correct sampling and subsampling processes to limit preferential selection or loss of sample media. • Use sample handling processes, including proper sample preservation, that limit the loss or gain of constituents to the sample media. • Analytical data that are known to be affected by either sampling or analytical bias are flagged to indicate possible bias. • Laboratories that are known to generate biased data for a specific analyte are asked to correct their methods to remove the bias as practicable. Otherwise, samples are sent to other laboratories for analysis.
Sensitivity (no QC element; addressed via method detection limit, practical quantitation limit, and relative percent difference)	Sensitivity is an instrument's or method's minimum concentration that can be reliably measured (i.e., instrument detection limit or limit of quantitation).	Determine the minimum concentration or attribute to be measured by an instrument (instrument detection limit) or by a laboratory (limit of quantitation). The lower limit of quantitation[c] is the lowest level that can be routinely quantified and reported by a laboratory.	If detection limits do not meet objective: • Request reanalysis or remeasurement using methods or analytical conditions that will meet required detection or limit of quantitation. • Qualify/reject the data before use.

Note: Based on SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium* (Chapter 1, July 2014).

[a]Acceptance criteria for QC elements are provided in Table 11-5.

[b]Field transfer blanks are utilized only when samples for volatile organic compounds (VOCs) are collected.

[c]For purposes of final status groundwater monitoring plans and this QAPjP, the lower limit of quantitation is interchangeable with the practical quantitation limit.

QC = Quality control

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11.A.1.5 Documents and Records

The Prime Contractor Project Manager (or designee) is responsible for ensuring that the current version of the groundwater monitoring plan and the QAPjP and sampling protocol provided in this attachment are used and providing updates to field personnel. Actions to address potential updates to the final status monitoring program at a DWMU are provided within the associated monitoring plan.

Logbooks and data forms are used to document field activities. The logbooks are identified with a unique project name and number. Only authorized individuals may make entries into the logbooks. Logbooks will be controlled documents. Data forms are also identified with a unique project name and number, may be used to record the same field information as logbooks, and are referenced in the logbooks.

The FWS, SMR group, and field crew supervisors are responsible for alignment of field instructions with the groundwater monitoring plan.

Convenience copies of laboratory analytical results are maintained in the HEIS database.

Groundwater monitoring data collected under final status groundwater monitoring plans, including actual levels of constituents, are stored in electronic format (e.g., in the managed records area of the Integrated Document Management System). These records are required in accordance with WAC 173-303-645(8)(g), (9)(c) and (10)(c)(ii) and are to be maintained throughout the active life of a facility and post-closure care period (if any).

Groundwater monitoring results are reported annually.

11.A.2 Data Generation and Acquisition

This section addresses data generation and acquisition so the project's methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are appropriate and documented. Instrument calibration and maintenance, supply inspections, and data management are also discussed.

11.A.2.1 Analytical Method Requirements

Sample analytical methods that are utilized for final status groundwater monitoring plans are presented in Table 11-2. The sampling constituents required in each final status plan may vary; therefore, not every analyte or method in Table 11-2 may be utilized in any single monitoring plan.

An Ecology accreditation demonstrates that a laboratory's quality system, staff, facilities and equipment, test methods, records, and reports have been evaluated, and the evaluation indicates the laboratory has the capability to provide accurate, defensible data when using those test methods. Equivalent or updated U.S. Environmental Protection Agency (EPA) methods and nationally recognized standard methods for which laboratories have been accredited by Ecology may be substituted for the methods identified in Table 11-2. In the event that laboratory analytical capability for a constituent becomes unavailable, analysis of the constituent ceases until a laboratory with the required capacity and Ecology accreditations become available. Though not a RCRA requirement, it is recognized that other considerations necessitate the laboratory to have and maintain a current U.S. Nuclear Regulatory Commission or U.S. Nuclear Regulatory Commission Agreement State radiological license and DOE Consolidated Audit Program accreditation.

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
General Chemistry			
ALKALINITY	Alkalinity, total as CaCO3[c]	310.1, Standard Method 2320	5250
7664-41-7	Ammonia	350.1	210
24959-67-9	Bromide[d]	300, 9056	262.5
16887-00-6	Chloride[d]	300, 9056	400
57-12-5	Cyanide (total)	9012, 9014	15.75
57-12-5	Cyanide (free)	9014	4
18540-29-9	Hexavalent chromium	7196	10.5
14797-55-8	Nitrate, as NO3[d]	300, 9056	525
14797-65-0	Nitrite, as NO2[d]	300, 9056	525
14808-79-8	Sulfate[d]	300, 9056	1050
18496-25-8	Sulfide (total)	376.1, Standard Method 4500S	2100
Field Measurements			
N/A	pH	150.1, 9040, Standard Method 4500 H+	N/A
N/A	Dissolved oxygen	360.1, Standard Method 4500 O	N/A
N/A	Specific conductance	120.1, 9050, Standard Method 2510	N/A
N/A	Temperature	170.1	N/A
N/A	Turbidity	180.1, Standard Method 2130 B	N/A
Metals			
7429-90-5	Aluminum	6020	105
7440-36-0	Antimony	6020	5.25
7440-38-2	Arsenic	6020	10.5
7440-39-3	Barium	6020	5.25
7440-41-7	Beryllium	6020	1.05
7440-43-9	Cadmium	6020	2.1
7440-70-2	Calcium	6010	1050
7440-47-3	Chromium	6020	10.5
7440-48-4	Cobalt	6020	5.25
7440-50-8	Copper	6020	10
7439-89-6	Iron	6010	105

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
7439-92-1	Lead	6020	3.15
7439-95-4	Magnesium	6010	1050
7439-96-5	Manganese	6020	10.5
7439-97-6	Mercury	7470	0.5
7439-98-7	Molybdenum	6020	5.25
7440-02-0	Nickel	6020	21
7440-09-7	Potassium	6010	5250
7782-49-2	Selenium	6020	10.5
7440-22-4	Silver	6020	5.25
7440-23-5	Sodium	6010	1050
7440-28-0	Thallium	6020	2.1
7440-31-5	Tin	6020	10.5
7440-62-2	Vanadium	6010	52.5
7440-66-6	Zinc	6010	21
Alcohols			
67-56-1	Methanol	8015	5000
Volatile Organic Compounds			
75-34-3	1,1-Dichloroethane	8260	10
75-35-4	1,1-Dichloroethene (1,1-Dichloroethylene)	8260	10
71-55-6	1,1,1-Trichloroethane	8260	5
630-20-6	1,1,1,2-Tetrachloroethane	8260	2.1
79-00-5	1,1,2-Trichloroethane	8260	5
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane (Trichlorotrifluoroethane)	8260	10
79-34-5	1,1,2,2-Tetrachloroethane	8260	5
96-12-8	1,2-Dibromo-3-chloropropane	8260	5.25
106-93-4	1,2-Dibromoethane (Ethylene dibromide [EDB])	8260	5
107-06-2	1,2-Dichloroethane	8260	5
78-87-5	1,2-Dichloropropane	8260	5
156-60-5	trans-1,2-Dichloroethylene	8260	5
96-18-4	1,2,3-Trichloropropane	8260	5
10061-01-5	cis-1,3-Dichloropropene	8260	5
10061-02-6	trans-1,3-Dichloropropene	8260	5
110-57-6	trans-1,4-Dichloro-2-butene	8260	50
71-36-3	1-Butanol (n-Butyl alcohol)	8260	262.5
78-93-3	2-Butanone (Methyl ethyl ketone [MEK])	8260	10.5

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
67-64-1	2-Propanone (Acetone)	8260	20
591-78-6	2-Hexanone (Methyl butyl ketone [MBK])	8260	20
79-46-9	2-Nitropropane	8260	26.25
107-87-9	2-Pentanone	8260	10.5
108-10-1	4-Methyl-2-pentanone (Methyl isobutyl ketone [MIBK])	8260	10.5
75-05-8	Acetonitrile (Methyl cyanide)	8260	100
107-02-8	Acrolein	8260	100
107-13-1	Acrylonitrile	8260	100
107-05-1	Allyl chloride	8260	10.5
71-43-2	Benzene	8260	5
75-27-4	Bromodichloromethane	8260	5
75-25-2	Bromoform	8260	5
75-15-0	Carbon disulfide	8260	5
56-23-5	Carbon tetrachloride	8260	3
156-59-2	cis-1,2-Dichloroethylene	8260	5
108-90-7	Chlorobenzene	8260	5
75-00-3	Chloroethane	8260	10
67-66-3	Chloroform	8260	5
126-99-8	Chloroprene (Chloro-1,3-butadiene; 2-)	8260	10
110-82-7	Cyclohexane	8260	2.1
108-94-1	Cyclohexanone	8260	105
124-48-1	Dibromochloromethane	8260	5
106-46-7	p-Dichlorobenzene (1,4-Dichlorobenzene)	8260	4
75-71-8	Dichlorodifluoromethane	8260	10
141-78-6	Ethyl acetate	8260	5000
100-41-4	Ethylbenzene	8260	4
60-29-7	Ethyl ether (Diethyl ether)	8260	5
97-63-2	Ethyl methacrylate	8260	10.5
78-83-1	Isobutanol (Isobutyl alcohol)	8260	500
67-63-0	Isopropyl alcohol (2-Propanol)	8260	100
126-98-7	Methacrylonitrile (2-Propenenitrile, 2-methyl-)	8260	10.5
74-83-9	Methyl bromide (Bromomethane)	8260	10
74-87-3	Methyl chloride (Chloromethane)	8260	10
74-88-4	Methyl iodide (Iodomethane)	8260	10.5
80-62-6	Methyl methacrylate (2-Propenoic acid, 2-methyl-, methyl ester)	8260	10.5

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
74-95-3	Methylene bromide (Dibromomethane)	8260	10
75-09-2	Methylene chloride (Dichloromethane)	8260	5.25
107-12-0	Propionitrile (Ethyl cyanide)	8260	21
100-42-5	Styrene	8260	5
127-18-4	Tetrachloroethene (Tetrachloroethylene; Perchloroethylene)	8260	5
109-99-9	Tetrahydrofuran	8260	50
108-88-3	Toluene	8260	5
79-01-6	Trichloroethylene (Trichloroethene [TCE])	8260	2.1
75-69-4	Trichlorofluoromethane	8260	10
108-05-4	Vinyl acetate	8260	50
75-01-4	Vinyl chloride (Chloroethene; Chloroethylene)	8260	10
1330-20-7	Xylene (total) (mixed isomers)	8260	10
Semivolatile Organic Compounds			
134-32-7	1-Naphthylamine	8270	25
95-50-1	1,2-Dichlorobenzene (o-Dichlorobenzene)	8270	10.5
120-82-1	1,2,4-Trichlorobenzene	8270	13
95-94-3	1,2,4,5-Tetrachlorobenzene	8270	20
123-91-1	1,4-Dioxane (1,4-Diethylene dioxide)	8270	21
130-15-4	1,4-Naphthoquinone	8270	52.5
53-96-3	2-Acetylaminofluorene	8270	105
91-58-7	2-Chloronaphthalene (Beta-chloronaphthalene)	8270	10.5
95-57-8	2-Chlorophenol	8270	10.5
95-48-7	2-Methylphenol (o-Cresol)	8270	10.5
91-57-6	2-Methylnaphthalene	8270	10.5
91-59-8	2-Naphthylamine	8270	10.5
88-75-5	2-Nitrophenol (o-Nitrophenol)	8270	10.5
109-06-8	2-Picoline	8270	21
58-90-2	2,3,4,6-Tetrachlorophenol	8270	52.5
120-83-2	2,4-Dichlorophenol	8270	10.5
105-67-9	2,4-Dimethylphenol (2,4-Xylenol)	8270	10.5
51-28-5	2,4-Dinitrophenol	8270	52.5
121-14-2	2,4-Dinitrotoluene	8270	10.5
95-95-4	2,4,5-Trichlorophenol	8270	10.5
88-06-2	2,4,6-Trichlorophenol	8270	10.5
87-65-0	2,6-Dichlorophenol	8270	10.5

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
606-20-2	2,6-Dinitrotoluene	8270	10.5
56-49-5	3-Methylcholanthrene	8270	21
108-39-4	3-Methylphenol (m-Cresol)	8270	[e]
106-44-5	4-Methylphenol (p-Cresol)	8270	[e]
91-94-1	3,3′-Dichlorobenzidine	8270	105
119-93-7	3,3′-Dimethylbenzidine	8270	50
92-67-1	4-Aminobiphenyl	8270	52.5
101-55-3	4-Bromophenyl phenyl ether	8270	10.5
59-50-7	4-Chloro-3-methylphenol (p-Chloro-m-cresol)	8270	10.5
7005-72-3	4-Chlorophenyl phenyl ether	8270	10.5
56-57-5	4-Nitroquinoline 1-oxide	8270	105
534-52-1	4,6-Dinitro-o-cresol (4,6-Dinitro-2-methyl phenol)	8270	52.5
99-55-8	5-Nitro-o-toluidine (Methyl-5-nitroaniline; 2-)	8270	21
57-97-6	7,12-Dimethylbenz[a]anthracene	8270	21
83-32-9	Acenaphthene	8270	10.5
208-96-8	Acenaphthylene	8270	10.5
98-86-2	Acetophenone	8270	10.5
62-53-3	Aniline	8270	10.5
120-12-7	Anthracene (PAH)	8270 SIM	10
140-57-8	Aramite	8270	20
56-55-3	Benz[a]anthracene (Benzo[a]anthracene) (PAH)	8270 SIM	0.3
205-99-2	Benz[e]acephenanthrylene (Benzo[b]fluoranthene) (PAH)	8270 SIM	0.5
207-08-9	Benzo[k]fluoranthene (PAH)	8270 SIM	0.5
191-24-2	Benzo[ghi]perylene (PAH)	8270 SIM	1
50-32-8	Benzo[a]pyrene (PAH)	8270 SIM	0.5
100-51-6	Benzyl alcohol	8270	10.5
111-91-1	Bis(2-chloroethoxy)methane	8270	10.5
111-44-4	Bis(2-chloroethyl)ether	8270	10.5
108-60-1	Bis(2-chloro-1-methylethyl)ether (2,2'-Oxybis[1-chloropropane])	8270	10.5
117-81-7	Bis(2-ethylhexyl)phthalate	8270	15.7
85-68-7	Butyl benzyl phthalate (Benzyl butyl phthalate)	8270	10.5
106-47-8	p-Chloroaniline (4-Chloroaniline)	8270	10.5
218-01-9	Chrysene (PAH)	8270 SIM	3

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
53-70-3	Dibenz[a,h]anthracene (Dibenzanthracene, 1,2,5,6-) (PAH)	8270 SIM	1
132-64-9	Dibenzofuran	8270	10.5
541-73-1	m-Dichlorobenzene (1,3-Dichlorobenzene)	8270	10.5
84-66-2	Diethyl phthalate	8270	10.5
297-97-2	O,O-Diethyl O-2-pyrazinyl phosphorothioate (Thionazin)	8270	52.5
60-11-7	p-(Dimethylamino)azobenzene	8270	21
122-09-8	alpha, alpha-Dimethylphenethylamine	8270	52.5
131-11-3	Dimethyl phthalate	8270	10.5
84-74-2	Di-n-butylphthalate (Dibutyl phthalate)	8270	10.5
99-65-0	m-Dinitrobenzene (1,3-Dinitrobenzene)	8270	10.5
117-84-0	Di-n-octylphthalate	8270	10.5
122-39-4	Diphenylamine	8270	10.5
62-50-0	Ethyl methanesulfonate	8270	10.5
206-44-0	Fluoranthene (PAH)	8270 SIM	5
86-73-7	9H-Fluorene (Fluorene) (PAH)	8270 SIM	3
118-74-1	Hexachlorobenzene (PAH)	8270 SIM	3
87-68-3	Hexachlorobutadiene	8270	10.5
77-47-4	Hexachlorocyclopentadiene	8270	10.5
67-72-1	Hexachloroethane	8270	10.5
70-30-4	Hexachlorophene	8270	525
1888-71-7	Hexachloropropene	8270	105
193-39-5	Indeno(1,2,3-cd)pyrene (PAH)	8270 SIM	0.3
78-59-1	Isophorone	8270	10.5
120-58-1	Isosafrole	8270	21
91-80-5	Methapyrilene	8270	52.5
66-27-3	Methyl methanesulfonate	8270	10.5
91-20-3	Naphthalene (PAH)	8270 SIM	10
98-95-3	Nitrobenzene	8270	10.5
88-74-4	o-Nitroaniline (2-Nitroaniline)	8270	21
99-09-2	m-Nitroaniline (3-Nitroaniline)	8270	21
100-01-6	p-Nitroaniline (4-Nitroaniline)	8270	21
100-02-7	p-Nitrophenol (4-Nitrophenol)	8270	21
924-16-3	n-Nitrosodi-n-butylamine	8270	10.5
55-18-5	n-Nitrosodiethylamine	8270	10.5
62-75-9	n-Nitrosodimethylamine (Dimethyl nitrosamine)	8270	10.5

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
86-30-6	n-Nitrosodiphenylamine	8270	[f]
621-64-7	n-Nitroso-di-n-dipropylamine (n-Nitrosodipropylamine; Di-n-propylnitrosamine)	8270	10.5
10595-95-6	n-Nitrosomethylethalamine (Ethanamine, n-methyl-n-nitroso-)	8270	10.5
59-89-2	n-Nitrosomorpholine	8270	10.5
100-75-4	n-Nitrosopiperidine	8270	10.5
930-55-2	n-Nitrosopyrrolidine	8270	10.5
608-93-5	Pentachlorobenzene	8270	10.5
76-01-7	Pentachloroethane	8270	52.5
82-68-8	Pentachloronitrobenzene	8270	52.5
87-86-5	Pentachlorophenol	8270	52.5
62-44-2	Phenacetin	8270	21
85-01-8	Phenanthrene (PAH)	8270 SIM	10
108-95-2	Phenol	8270	10.5
106-50-3	p-Phenylenediamine	8270	525
129-00-0	Pyrene (PAH)	8270 SIM	5
110-86-1	Pyridine	8270	21
94-59-7	Safrole	8270	21
3689-24-5	Tetraethyl dithiopyrophosphate (Sulfotep)	8270	50
95-53-4	o-Toluidine (Methylaniline; 2-)	8270	20
126-68-1	O,O,O-Triethyl phosphorothioate	8270	52.5
99-35-4	sym-Trinitrobenzene (Trinitrobenzene; 1,3,5-)	8270	52.5
Polychlorinated Biphenyls			
12674-11-2	Aroclor 1016	8082	1.05
11104-28-2	Aroclor 1221	8082	1.05
11141-16-5	Aroclor 1232	8082	1.05
53469-21-9	Aroclor 1242	8082	1.05
12672-29-6	Aroclor 1248	8082	1.05
11097-69-1	Aroclor 1254	8082	1.05
11096-82-5	Aroclor 1260	8082	1.05
Herbicides			
94-75-7	2,4-D (2,4-Dichlorophenoxy acetic acid)	8151	20
93-76-5	2,4,5-T (2,4,5-Trichlorophenoxyacetic acid)	8151	1.05
2303-16-4	Diallate	8270	21
88-85-7	Dinoseb (2-sec-Butyl-4,6-dinitrophenol)	8270	21

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
23950-58-5	Pronamide	8270	21
93-72-1	Silvex (2,4,5-TP)	8151	1.05
Pesticides			
72-54-8	4,4′-DDD	8081	0.1
72-55-9	4,4′-DDE	8081	0.1
50-29-3	4,4′-DDT	8081	0.1
309-00-2	Aldrin	8081	0.0525
319-84-6	alpha-BHC (Hexachlorocyclohexane;alpha)	8081	0.0525
319-85-7	beta-BHC (Hexachlorocyclohexane;beta-)	8081	0.0525
319-86-8	delta-BHC (Hexachlorocyclohexane;delta-)	8081	0.0525
58-89-9	gamma-BHC (Lindane; Hexachlorocyclohexane)	8081	0.0525
57-74-9	Chlordane	8081	1.05
510-15-6	Chlorobenzilate	8270	10.5
60-57-1	Dieldrin	8081	0.0525
60-51-5	Dimethoate	8270	21
298-04-4	Disulfoton	8270	52.5
959-98-8	Endosulfan I	8081	0.0525
33213-65-9	Endosulfan II	8081	0.1
1031-07-8	Endosulfan sulfate	8081	0.1
72-20-8	Endrin	8081	0.1
7421-93-4	Endrin aldehyde	8081	0.1
52-85-7	Famphur	8270	105
76-44-8	Heptachlor	8081	0.0525
1024-57-3	Heptachlor epoxide	8081	0.0525
465-73-6	Isodrin	8270	10.5
143-50-0	Kepone	8270	100
72-43-5	Methoxychlor	8081	0.5
298-00-0	Methyl parathion (O,O-Dimethyl O-P-nitrophenyl, phosphorothioate)	8270	10.5
56-38-2	Parathion	8270	52.5
298-02-2	Phorate (Phosphorodithioic acid, O,O-diethyl S-(ethylthio) methyl ester)	8270	52.5
8001-35-2	Toxaphene	8081	2.625

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)
Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans (Totals and Congeners)			
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzodioxin	8290	5.25E-05
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran	8290	5.25E-05
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran	8290	5.25E-05
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran	8290	5.25E-05
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	8290	5.25E-05
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran	8290	5.25E-05
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	8290	5.25E-05
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran	8290	5.25E-05
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	8290	5.25E-05
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran	8290	5.25E-05
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	8290	5.25E-05
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran	8290	5.25E-05
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran	8290	5.25E-05
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran	8290	1.05E-05
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin	8290	1.05E-05
38998-75-3	Total heptachlorodibenzofurans	8290	5.37E-05
37871-00-4	Total heptachlorodibenzo-p-dioxins	8290	5.25E-05
55684-94-1	Total hexachlorodibenzofurans	8290	5.25E-05
34465-46-8	Total hexachlorodibenzo-p-dioxins	8290	1.05E-04
39001-02-0	Total octachlorodibenzofurans	8290	1.05E-04
3268-87-9	Total octachlorodibenzo-p-dioxins	8290	1.07E-04
30402-15-4	Total pentachlorodibenzofurans	8290	5.25E-05
36088-22-9	Total pentachlorodibenzo-p-dioxins	8290	5.25E-05
55722-27-5	Total tetrachlorodibenzofurans	8290	1.05E-05
41903-57-5	Total tetrachlorodibenzo-p-dioxins	8290	1.05E-05

[a]Value in this column is either the CAS number or the constituent identifier if no CAS number exists.

[b]For EPA Methods 180.1 and 300, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples.* For EPA Methods 120.1, 150.1, 170.1, 310.1, 350.1, 360.1, and 376.1, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*. For Standard Methods, see APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater*.

[c]For alkalinity, MDLs and PQLs are not strictly determinable [Source: 40 (Code of Federal Regulations [CFR] 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants*, Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit—Revision 1.11," paragraph 1(2)].

[d]Dilutions for certain ion chromatography constituents may be necessary, potentially raising the PQL above the limits provided.

[e]Analyzed and reported as 3 & 4 methylphenol (CAS number 65794-96-9). The PQL for 3 & 4 methylphenol is 20 µg/L.

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Table 11-2 Analytical Methods for Final Status Groundwater Monitoring Plans

CAS Number[a]	Waste Constituent (Alternate Name)	Analytical Method[b]	PQL (µg/L)

[f]Analyzed and reported as diphenylamine+n-nitrosodiphenylamine. The PQL for diphenylamine+n-nitrosodiphenylamine is 10.5 µg/L.

CAS = Chemical Abstracts Service

EPA = U.S. Environmental Protection Agency

MDL = Method detection limit

N/A = Not applicable

PQL = Practical quantitation limit

SIM = Selected ion monitoring

11.A.2.2 Field Analytical Methods

Field screening and survey data will be measured in accordance with applicable work practices. Field analytical methods may also be performed in accordance with manufacturer manuals. Section 11.B provides further discussion on field measurements.

11.A.2.3 Quality Control

Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to sampling variability. Laboratory QC samples estimate the precision, accuracy, bias, and matrix effects on the analytical data. Field and laboratory batch QC samples, and their typical frequencies, are summarized in Tables 11-3 and 11-4. The field QC sample frequencies are defined in terms of a "sample event" (e.g., 1 in 20 sample events). For groundwater, a sample event is any time a well is accessed for sampling. Field duplicate and full trip blank QC samples are collected for all groundwater monitoring wells sampled within any given month for AEA, CERCLA, and RCRA groundwater monitoring programs. For example, if a month has 181 wells scheduled across the groundwater monitoring programs, then ten field duplicates will be collected. A sample event is collected at a specific well and analyzed to one or more analytical methods. Acceptance criteria for field and laboratory QC for analyses performed at the analytical laboratory are shown in Table 11-5. Data will be qualified and flagged in the HEIS database, as appropriate. Samples are analyzed within the preservation and holding times provided in Section 11.A.2.3.3. The environmental analytical laboratories contracted to the Prime Contractor maintain internal QA and QC programs.

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Table 11-3 Groundwater Field Quality Control Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Equipment blank	Bias due to contamination from nondedicated sampling equipment	One in 20 sample events[a] when nondedicated equipment is used[b]
Field duplicate	Representativeness regarding the homogeneity of the sample matrix and the precision of the sampling and analysis processes. The degree of confidence in the comparability of sampling and analytical methods to allow comparison of one dataset to another. The precision of the sampling and analysis processes.	One in 20 sample events[a]
Field split	Inter laboratory comparability and the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another.	As needed (e.g., verification of sample results; SMR requests)
Field transfer blank	Bias due to contamination from sampling site for VOCs.	One each day VOCs are sampled; additional field transfer blanks are collected if VOC samples are acquired on the same day for multiple laboratories; analyzed for VOCs only
Full trip blank	Bias due to contamination from containers, preservative reagents, storage, or transportation.	One in 20 sample events[a]

[a]A sample is collected any time a well is accessed for sampling; this is also known as a sample event. Field duplicates and full trip blanks are run at a frequency of one in 20 sample events (i.e., five percent of the sample events) for all groundwater monitoring wells sampled within any given month (for all groundwater monitoring programs, not just those restricted to a single DWMU or waste site; and not 20 samples events all from the same well). For example, if a month has 181 wells scheduled, then ten field duplicates will be collected. A sample event is collected at a specific well and analyzed to one or more analytical methods.

[b]For portable pumps, equipment blanks are collected one per 20 sample events. Whenever a new type of nondedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

SMR = Sample Management and Reporting

VOC = Volatile organic compound

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Table 11-4 Laboratory Batch Quality Control Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Laboratory control sample	Laboratory accuracy, the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another, and bias due to laboratory analysis	1 per analytical batch[a,b]
Laboratory control sample duplicate	Precision of analysis processes and the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another	1 per analytical batch if sample restrictions exist and as directed by SMR[a,b]
Laboratory sample duplicate	Precision of analysis processes	1 per analytical batch[a,b]
Matrix spike	Laboratory accuracy, the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another, and bias due to laboratory analysis or matrix effects	1 per analytical batch[a,b]
Matrix spike duplicate	Precision of analysis processes: the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another	1 per analytical batch[a,b]
Method blank	Bias due to contamination from laboratory analysis	1 per analytical batch[a,b]
Surrogate	Laboratory accuracy for organic compounds	Added to each sample and QC sample for organic analysis[b]

[a]A batch is a group of up to 20 samples that behave similarly with respect to the sampling or testing procedures being employed and which are processed as a unit. Batching across projects is allowed for similar matrices (e.g., Hanford Site groundwater).

[b]Unless not required by, or different frequency is called out, in laboratory analysis method.

SMR = Sample Management and Reporting

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Table 11-5 Field and Laboratory Quality Control Elements and Acceptance Criteria for Laboratory Analyses

Analyte/Method[a]	QC Element	Acceptance Criteria	Corrective Action
General Chemistry			
Alkalinity	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Ammonia	MB	<MDL or < 5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Hexavalent chromium	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	< MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Anions by IC	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Cyanide (total)	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"

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Table 11-5 Field and Laboratory Quality Control Elements and Acceptance Criteria for Laboratory Analyses

Analyte/Method[a]	QC Element	Acceptance Criteria	Corrective Action
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Free cyanide	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Sulfide	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Metals			
Metals by ICP-AES	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Metals by ICP-MS	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"

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Table 11-5 Field and Laboratory Quality Control Elements and Acceptance Criteria for Laboratory Analyses

Analyte/Method[a]	QC Element	Acceptance Criteria	Corrective Action
Mercury by cold-vapor atomic absorption	MB	<MDL or <5% sample concentration	Flag with "C"
	LCS	80%-120% recovery	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	75%-125% recovery	Flag with "N"
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Volatile Organic Compounds			
Volatile organics by GC-MS	MB	<MDL[f] or <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[g]	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	70%-130% recovery	Flag with "T"
	SUR	70%-130% recovery	Review data[e]
	EB, FTB, FXR	<MDL[f] or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Alcohols			
Methanol	MB	<MDL or <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[g]	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	70%-130% recovery	Flag with "N"
	SUR	60%-140% recovery	Review data[e]
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Semivolatile Organic Compounds			
Herbicides by GC	MB	<MDL or <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[g]	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	% recovery statistically derived[g]	Flag with "N"

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Table 11-5 Field and Laboratory Quality Control Elements and Acceptance Criteria for Laboratory Analyses

Analyte/Method[a]	QC Element	Acceptance Criteria	Corrective Action
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Polychlorinated biphenyls (PCBs by GC)	MB	<MDL or <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[g]	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	% recovery statistically derived[g]	Flag with "N"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Pesticides by GC	MB	<MDL or <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[g]	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	% recovery statistically derived[g]	Flag with "N"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Phenols by GC-MS	MB	<MDL or <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[g]	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	% recovery statistically derived[g]	Flag with "T"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"

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Table 11-5 Field and Laboratory Quality Control Elements and Acceptance Criteria for Laboratory Analyses

Analyte/Method[a]	QC Element	Acceptance Criteria	Corrective Action
Semivolatile organics by GC-MS	MB	<MDL[f] or <5% sample concentration	Flag with "B"
	LCS	70%-130% recovery or % recovery statistically derived[g]	Flag with "O"[b]
	DUP[c] or MS/MSD[d]	≤20% RPD	Review data[e]
	MS/MSD	% recovery statistically derived[g]	Flag with "T"
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<MDL[f] or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"
Dioxins and furans, total and/or congeners by HRGC/HRMS	MB	<PQL or <5% sample concentration	Flag with "B"
	LCS	% recovery statistically derived[g]	Flag with "O"[b]
	DUP[c]	≤20% RPD	Review data[e]
	SUR	% recovery statistically derived[g]	Review data[e]
	EB, FTB	<PQL or <5% sample concentration	Flag with "Q"
	Field duplicate[c]/field split	≤20% RPD	Flag with "Q"

Note: This table applies only to laboratory analyses. Field measurements (e.g., specific conductance, pH, dissolved oxygen, temperature, and turbidity) are not listed because they are measured in the field.

[a]This table provides QC elements and acceptance criteria for sampling under final status groundwater monitoring plans. The sampling constituents required in each of the final status plans may vary; therefore, not every analyte and method in this table may be applicable to any single monitoring plan.

[b]The reporting laboratory will apply the "O" flag with SMR concurrence.

[c]Applies when at least one result is greater than the laboratory PQL.

[d]Either a sample duplicate or a MSD is to be analyzed to determine measurement precision (if there is insufficient sample volume, an LCSD is analyzed with the acceptance criteria defaulting to the DUP/MSD criteria).

[e]After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data.

[f]For the common laboratory contaminants acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criterion is less than five times the MDL.

[g]Laboratory-determined, statistically derived control limits based on historical data are used here. Control limits are reported with the data.

DUP = Laboratory sample duplicate
EB = Equipment blank
FTB = Full trip blank
FXR = Field transfer blank
GC = Gas chromatography
GC-MS = Gas chromatography – mass spectrometry
HRGC = High-resolution gas chromatography
HRMS = High-resolution mass spectrometry
IC = Ion chromatography
LCS = Laboratory control sample
LCSD = Laboratory control sample duplicate
MB = Method blank
MDL = Method detection limit
MS = Matrix spike
MSD = Matrix spike duplicate
PCB = Polychlorinated biphenyl
PQL = Practical quantitation limit
QC = Quality control

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Table 11-5 Field and Laboratory Quality Control Elements and Acceptance Criteria for Laboratory Analyses

Analyte/Method[a]	QC Element	Acceptance Criteria	Corrective Action

ICP-AES = Inductively coupled plasma – atomic emission spectroscopy

ICP-MS = Inductively coupled plasma – mass spectrometry

RPD = Relative percent difference

SMR = Sample Management and Reporting

SUR = Surrogate

Data Flags:

B, C = Possible laboratory contamination: analyte was detected in the associated method blank – laboratory applied. The B flag is used for organic analytes and radioanalytes. The C flag is used for general chemical parameters and inorganic analytes.

N = Result may be biased: associated MS/MSD result was outside the acceptance limits (all methods except GC-MS) – laboratory applied.

O= Result may be biased: associated laboratory control sample result was outside the acceptance limits – laboratory applied.

Q = Problem with associated field QC samples: results were out of limits – SMR review.

T = Result may be biased: associated MS/MSD result was outside the acceptance limits (GC-MS only) – laboratory applied.

11.A.2.3.1 Field Quality Control Samples

Field QC samples are used to monitor the integrity of field samples during sample collection, transportation, storage, and laboratory analysis. Field QC samples are submitted to the analyzing laboratories as field samples. Field QC samples are analyzed for the same set of analytes as their corresponding field samples. Field QC samples may include field duplicates, field split samples, and three types of field blanks (equipment blanks, field transfer blanks, and full trip blanks). Field blanks are typically prepared to match the sample matrix as closely as possible using high-purity water.[1] The following describes the QC samples in more detail:

- Equipment blanks: Equipment blanks are used to monitor the effectiveness of the decontamination process for reusable sampling equipment. Equipment blanks are not usually required for dedicated sampling equipment or disposable sampling equipment. They are samples of high-purity water contacted with the sampling surfaces of equipment used to collect samples prior to using that equipment for field sampling. Equipment blanks are collected from each type of reusable sampling equipment to evaluate the effectiveness of decontamination processes for the specific equipment types. Equipment blanks will be analyzed for the same analytes as samples collected using that equipment.
- Field duplicates: Field duplicates provide information regarding the homogeneity (i.e., representativeness) of the sample matrix, the precision of the sampling and analysis processes, and the degree of confidence in the comparability of sampling and analytical methods to allow comparison of one dataset to another. Field duplicates are intended to be identical to the sample, and are collected as close as possible in time and location to the sample. Each sample in the sample-duplicate pair receives its own unique set of sample numbers.
- Field splits: Field splits serve as interlaboratory comparison samples and are a variation of field duplicate samples. Field splits are intended to be identical and are collected as close as possible in time and location to the sample. Field splits will be stored in separate containers and analyzed by different laboratories for the same analytes.

[1] High-purity water is generally defined as water that has been distilled, deionized, or any combination of distillation, deionization, reverse osmosis, activated carbon filtration, ion exchange, particulate filtration, or other polishing techniques.

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- Field transfer blanks: Field transfer blanks are analyzed for VOCs only and are used to document possible contamination during field acquisition of VOC samples. Field transfer blanks are sample bottles (already containing the sample preservative) filled at the sample collection site with high-purity water. The blank is sealed at the sampling site and becomes part of the sample set sent to the laboratory.
- Full trip blanks: Full trip blanks are used to monitor for potential sample contamination from the sampling container, preservation reagents, storage conditions, or transportation. Full trip blanks are prepared and sealed prior to traveling to the sampling site, transported to the sampling site (not opened in the field), and then shipped as part of the sample set to the laboratory.

11.A.2.3.2 Laboratory Quality Control Samples

Laboratory QC may include batch QC consisting of LCSs, LCSDs, DUPs, MSs, MSDs, MBs, and SURs. These QC analyses follow EPA methods (e.g., those in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*). QC checks outside of control limits are documented in analytical laboratory reports and during a DQI evaluation, if performed. Descriptions of the various types of laboratory QC samples are as follows:

- Laboratory control sample: A control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material used to evaluate laboratory accuracy, the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another, and bias due to laboratory analysis.
- Laboratory control sample duplicate: An additional control matrix (e.g., reagent water) spiked with analytes representative of the target analytes or a certified reference material. The LCSD is used to evaluate the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another and to establish precision when there is insufficient sample material to perform a MS/MSD pair.
- Laboratory sample duplicate: A second aliquot of a sample taken through the entire sample preparation and analytical process. DUPs are used to evaluate the precision of a method in a given sample matrix.
- Matrix spike: An aliquot of a sample spiked with a known concentration of target analyte(s) taken through the entire sample preparation and analytical process. The MS is used to evaluate laboratory accuracy, assess the bias of a method in a given sample matrix, and evaluate the degree of confidence in the comparability of analytical methods to allow comparison of one dataset to another. Thus, MS results are an indicator of the effect the sample matrix has on the accuracy of measurement of the target analytes.
- Matrix spike duplicate: A replicate spiked aliquot of a sample taken through the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.
- Method blank: An analyte-free matrix to which the same reagents are added in the same volumes or proportions as used in the sample processing. The MB is carried through the complete sample preparation and analytical process. The MB is used to estimate the bias due to potential contamination resulting from the sample preparation and analysis.
- Surrogate: Used only in organic analyses, a SUR is an organic compound added to every sample in the analysis batch (field samples and batch QC samples) prior to preparation. The SUR is typically similar in chemical composition to the analyte being determined, but is not normally encountered in environmental samples. SURs are expected to respond to the preparation and analytical process in a manner similar to the analytes of interest. Because SURs are added to every sample and batch QC sample, they are used to evaluate overall analytical method performance (i.e., accuracy) in a given matrix.

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11.A.2.3.3 Sample Preservation and Holding Times

Samples are analyzed using the guidelines for preservation and holding times provided in Table 11-6. Holding times and preservation methods are dependent on the constituent and are consistent with EPA guidance and approved analytical methods. Due to the time lag that occurs when samples are transported from the field to an analytical laboratory, sample preservation may be necessary to maintain the integrity of the samples. Furthermore, in some instances, constituents in the samples not analyzed within the holding times may be compromised by volatilization, decomposition, chemical changes, or biological activity. Data from samples analyzed outside of the holding times are flagged in the HEIS database with an "H."

Table 11-6 Groundwater Sample Preservations and Holding Times Guidelines

Analyte/Method[a]	Preservation[b]	Holding Times
General Chemistry		
Alkalinity	Cool ≤6°C	14 days
Ammonia	Cool ≤6°C, adjust pH to <2 with H_2SO_4	28 days
Hexavalent chromium	Cool ≤6°C	24 hours
Bromide, Chloride, Sulfate by IC	Cool ≤6°C	28 days
Nitrate, Nitrite by IC	Cool ≤6°C	48 hours
Cyanide (total)	NaOH to pH ≥12 Cool ≤6°C	14 days
Cyanide (free)	NaOH to pH ≥12 Cool ≤6°C	14 days
Sulfide	ZnAc+NaOH to pH > 9 Cool ≤6°C	7 days
Metals		
Metals by ICP-AES	HNO_3 to pH <2	6 months
Metals by ICP-MS	HNO_3 to pH <2	6 months
Mercury by cold-vapor atomic absorption	HNO_3 to pH <2	28 days
Volatile Organic Compounds		
Volatile organics by GC-MS	HCl or H_2SO_4 to pH <2 Cool ≤6°C	7 days unpreserved 14 days preserved
Alcohols		
Methanol	HCl to pH <2 Cool ≤6°C	7 days unpreserved 14 days preserved
Semivolatile Organic Compounds		
Herbicides by GC	Cool ≤6°C	7 days before extraction 40 days after extraction
Polychlorinated biphenyls (PCBs by GC)	Cool ≤6°C	1 year before extraction 40 days after extraction

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Table 11-6 Groundwater Sample Preservations and Holding Times Guidelines

Analyte/Method[a]	Preservation[b]	Holding Times
Pesticides by GC	Cool ≤6°C	7 days before extraction 40 days after extraction
Phenols by GC-MS	Cool ≤6°C	7 days before extraction 40 days after extraction
Semivolatile organics by GC-MS	Cool ≤6°C	7 days before extraction 40 days after extraction
Dioxins/Furans, total and/or congeners by HRGC/HRMS	Cool ≤6°C	30 days before extraction 45 days after extraction

Notes: Holding times and preservation methods are dependent on the constituent and are consistent with EPA guidance and approved analytical methods.

The container type for a sample is available on the chain-of-custody documentation.

This table applies only to laboratory analyses. Field measurements (e.g., specific conductance, pH, dissolved oxygen, temperature, and turbidity) are not listed because they are measured in the field.

[a]This table provides sample preservation and holding times guidelines for sampling under final status groundwater monitoring plans. The sampling constituents required in each of the final status plans may vary; therefore, not every analyte and method in this table may be applicable to any single monitoring plan.

[b]For samples that are cooled, ensure samples are sufficiently cooled to a temperature of ≤6°C, but not frozen.

EPA = U.S. Environmental Protection Agency
GC = Gas chromatography
GC-MS = Gas chromatography – mass spectrometry
HRGC = High-resolution gas chromatography
HRMS = High-resolution mass spectrometry
IC = Ion chromatography
ICP-AES = Inductively coupled plasma – atomic emission spectroscopy
ICP-MS = Inductively coupled plasma – mass spectrometry
PCB = Polychlorinated biphenyl

11.A.2.4 Instrument and Equipment Testing, Inspection, and Maintenance

Each measuring equipment user will ensure equipment is functioning as expected and is properly handled. Onsite environmental instrument testing, inspection, and maintenance will be recorded according to approved methods.

Collection, measurement, and testing equipment will meet applicable standards or have been evaluated as acceptable and valid according to instrument-specific methods and specifications. Software applications will be acceptance tested prior to use in the field. Measurement and testing equipment used in the field will be subject to preventive maintenance measures to minimize downtime.

11.A.2.5 Instrument/Equipment Calibration and Frequency

Field equipment calibration is discussed in Section 11.B.

11.A.2.6 Inspection/Acceptance of Supplies and Consumables

Consumables, supplies, and reagents will be reviewed per test methods in the SW-846 Compendium and EPA/600 Method series (e.g., EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*) and will be appropriate for their use. Supplies and consumables used in support of sampling and analysis activities are procured under internal work processes. Supplies and consumables are checked and accepted by users prior to use.

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11.A.2.7 Nondirect Measurements

Data obtained from sources such as computer databases, programs, literature files, and historical records will be evaluated by staff assigned by the Prime Contractor Project Manager. Data used in evaluations will be identified by source. Historical data obtained from the HEIS database are usable for comparison to data collected under final status groundwater monitoring plans without further QC review.

11.A.2.8 Data Management

Records of data analyses are maintained as required by WAC 173-303-645(8)(j).

Electronic data access will be through a Hanford Site database (e.g., HEIS). Where electronic data are not available, hard copies will be provided.

11.A.3 Data Usability Assessment

This section addresses QA activities that occur after data collection. Implementation of these QA activities determines whether the data conform to the specified QA criteria, thus satisfying the project objectives.

In addition, a staff member or designee assigned by the Prime Contractor Project Manager performs a data evaluation. This data evaluation is not part of the QA activities; rather, it corresponds to the data evaluations discussed in the final status groundwater monitoring plans (e.g., data comparison to defined values, corrosion evaluation, etc.). During the staff member's or designee's data evaluation, potential data errors might be found which might result in a request for an SMR or laboratory data review on the questionable data. This information, if any, is passed along for inclusion in the data verification QA activity.

11.A.3.1 Data Verification

Data verification is the in-house SMR process of evaluating the completeness, correctness, and conformance/compliance of a specific data package against what was requested. Data verification is performed to confirm that field sampling, field QC sampling, and chain-of-custody documentation are complete. This verification includes linking sample numbers to specific sampling locations and reviewing sample collection dates, sample preparation, and analysis dates to determine if holding times were met.

The criteria for verification include, but are not limited to, review that samples were analyzed as requested, use of the correct analytical method, and data packages are free of transcription errors. Data verification is typically conducted on a minimum of 25 percent of analytical data deliverables of samples (i.e., groundwater, soil, resins, structural components debris, etc.) collected across all projects supported by SMR.

11.A.3.2 Data Validation

Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond data verification to determine the analytical quality of a specific dataset. Data validation is performed at the discretion of the Prime Contractor Project Manager and executed by a qualified independent, third-party vendor. Analytical data validation provides checks that an analyte is present or absent, confirms analytical data packages comply with project QA requirements, checks analytical QC control values against defined QC limits, and applies data validation review qualifiers to define the data use limitations of the reviewed data. Data validation is based on the process described in EPA 540-R-20-005, *National Functional Guidelines for Organic Superfund Methods Data Review*; and EPA 542-R-20-006, *National Functional Guidelines for Inorganic Superfund Methods Data Review*, adjusted for use with SW 846. Level C data validation is generally equivalent to Level 2A in OSWER Directive 9200.1-85, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*. If conducted, Level C data validation will be performed at a minimum frequency of 5 percent per method.

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11.A.3.3 Reconciliation with User Requirements

The purpose of reconciliation with user requirements is to determine if a decision can be made with the desired confidence, given the quality of a given dataset (i.e., the quantitative data are of the correct type and are of adequate quality and quantity as determined necessary during the planning process). The data usability assessment (DUA) process in conjunction with the data evaluation performed by the staff member or designee assigned by the Prime Contractor Project Manager completes the reconciliation with user requirements.

Typically, the DUA process consists of data verification and data validation; includes either a data quality assessment (DQA) and DQI evaluation or only a DQI evaluation depending on the type of sampling design used; and is documented in a summary report. For statistical sampling designs (probability sampling), the DUA uses the DQA[2] process and the DQI evaluation may be performed. For non-statistical sampling designs, the DUA uses only a DQI evaluation to assess data usability. Data verification and data validation are integral to both the DQA evaluation process and the DQI evaluation process.

For nonstatistical sampling designs as employed at DWMUs, a DQI evaluation is used to assess data usability. A DQI evaluation assesses the quality and usability of individual results in terms of precision, accuracy, representativeness, comparability, completeness, bias, and sensitivity. When judgmental (nonstatistical) sampling designs are implemented, DQIs for the specific datasets (individual data packages) will be evaluated in accordance with EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8)* and SW-846. For groundwater monitoring, DQIs for the specific datasets will typically be evaluated for long-term, ongoing AEA, CERCLA, and RCRA groundwater monitoring programs on an annual basis.

A DUA involves assessing sampling and analytical data against the user data QA requirements. Therefore, the DUA compares field sampling activities against applicable sampling documents and field sampling paperwork and provides an evaluation of the resulting data. If requested, a unit-specific DUA is performed to the specific data quality requirements provided in this QAPjP and is initiated by the Prime Contractor Project Manager in conjunction with SMR.

Results of the unit-specific DUA are used to determine if data collected under the final status groundwater monitoring plans meets the QA criteria and collection activities established as necessary for the data to be used in technical interpretations and project decision making. The DUA process is not intended to be a definitive analysis of a project or problem, nor an evaluation of the planning process objectives. Rather, the DUA process provides an initial assessment of the reasonableness of the generated data based solely on the associated QC information and not on the technical interpretations of the data values.

11.B Sampling Protocol

Groundwater monitoring at the Hanford Site, as defined by RCRA and implemented in WAC 173-303 has been conducted since the mid-1980s. Hanford Site groundwater sampling methods contain sampling precautions to be taken; identify equipment and its use; cleaning and decontamination practices; records and documentation; and sample collection, management, and control activities. Together, Sections 11.A and 11.B discuss the sampling and analysis elements for final status groundwater monitoring plans: sample collection, sample preservation and holding times, chain-of-custody control, analytical methods, and field and laboratory QA/QC.

[2] As the DQA process is appropriate only for analytical results obtained through statistical sampling designs, it is not applicable to the nonstatistical (judgmental) sampling designs implemented for groundwater monitoring at DWMUs and is not discussed further.

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This section provides elements of the sampling protocols and techniques used for final status groundwater monitoring plans. Each of the DWMU-specific groundwater monitoring plans identifies the monitoring wells that will be sampled, constituents to be analyzed, and sampling frequency for the groundwater monitoring at the DWMU. Training requirements for groundwater monitoring personnel are provided in Permit Attachment 8, *Inspection and Training Plan for Groundwater Monitoring Wells* of the Site-wide Permit.

11.B.1 Sampling Methods

Sampling may include but is not limited to the following methods:

- Field screening measurements.
- Groundwater sampling.
- Water-level measurements.

Groundwater samples will be collected according to the current and applicable field practices. Groundwater samples are collected after field measurements of purged groundwater have stabilized as follows:

- pH – two consecutive measurements agree within 0.2 pH units.
- Temperature – two consecutive measurements agree within 0.2°C (0.4°F).
- Conductivity – two consecutive measurements agree within 10 percent of each other.
- Turbidity – less than 5 nephelometric turbidity units prior to sampling (or the recommendation by staff assigned by the Prime Contractor Project Manager at the time of collection).

Dissolved oxygen, if included in a groundwater monitoring plan, will also be measured in the field. Dissolved oxygen is not required to be stable prior to sample collection.

Environmental-grade electric submersible pumps will typically be used with a flow rate not exceeding 7.6 L/min (2 gal/min) for well purging and sample collection in existing wells. In the event a well exhibits insufficient productivity to support purging and sampling using the environmental-grade electric submersible pumps, adjustable-rate bladder pumps with typical flow rates of 0.1 to 0.5 L/min (0.026 to 0.13 gal/min) may be employed. As environmental-grade electric submersible pumps reach the end of their service lives due to age, normal wear, or failure, wells will be evaluated and they may be replaced with adjustable-rate bladder pumps. The same purge protocol described for environmental-grade electric submersible pumps will be used for the adjustable-rate bladder pumps.

Dedicated pumps (i.e., submersible pumps placed semi-permanently in monitoring wells) may be used for well purging and sampling. In all wells using dedicated pumps, the depth to the water table will be determined at each well, and the placement of the pump intake will be in the upper portion of the unconfined aquifer (e.g., within 3.1 m [10 ft] of the measured water table depth). Dedicated pumps will be reset as needed to maintain the pump intake depth within the upper portion of the unconfined aquifer. Groundwater monitoring wells will be purged and sampled using purge and sample techniques and selected pump placement that increases the probability of representing groundwater conditions near the observed water table at the time of sampling.

The use of purge and sample techniques with a flow rate not typically exceeding 7.6 L/min (2 gal/min) increases the probability of collection of representative samples of groundwater near the water table in wells that have been constructed using longer screens (e.g., up to 9.1 m [30 ft]) than typically used for water table monitoring. The use of longer screens for RCRA groundwater monitoring wells contributes to a longer service life for wells in areas where declining water table elevations have historically rendered wells unusable after relatively short periods of time.

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Unless special directions are provided by the staff assigned by the Prime Contractor Project Manager at the time of the sample collection, wells are typically purged at a flow rate not to exceed 7.6 L/min (2 gal/min). Purging will continue until stable readings of selected field water quality parameters are achieved (as described above).

Field measurements (except for turbidity) are typically obtained using an instrumented flow-through cell located at the wellhead. Groundwater is pumped directly from the well to the flow-through cell. At the beginning of the sample event, field crews attach a clean stainless steel sampling manifold to the riser discharge. The manifold has two valves and two ports: one port is used only for purgewater, and the other port is used to supply water to the flow-through cell. Probes are inserted into the flow-through cell to measure pH, temperature, specific conductance, and dissolved oxygen. Turbidity is measured by collecting an aliquot of water from the purgewater valve and inserting the sample vial into a turbidimeter. Purgewater, including the water passing through the flow-through cell, is then discharged to a tank on a purgewater truck.

Collection of the field measurement data will commence when a volume of water equal to the volume of the pump riser pipe has been extracted and discharged to a purgewater truck. When field measurements have stabilized, the hose supplying water to the flow-through cell is disconnected, and a clean stainless steel drop leg is attached for sampling collection. The flow rate does not typically exceed 7.6 L/min (2 gal/min) during sampling to minimize the loss of volatiles (if any) and prevent overfilling the bottles. Sample bottles are filled in a sequence designed to minimize loss of volatiles (if any). Filtered samples are collected after collection of the unfiltered samples.

Samples may be filtered in the field using a 0.45 µm filter as noted on the chain-of-custody form. Unfiltered samples are collected in conjunction with filtered samples to determine if metal constituents being monitored (excluding hexavalent chromium, if one of the monitored constituents) occur as both suspended and dissolved phases, or in only one state. The evaluation of suspended and dissolved metals provides supporting information for groundwater geochemical characteristics, as well as indication of well integrity such as the presence of dislodged well encrustation, well corrosion products, or failure of the well screen filter pack.

Based on the analytical methods used, preservatives are generally added to the collection bottles before their use in the field. Sample preservation and holding times for groundwater samples are provided in Section 11.A.2.3.3 and are based on the analytical method identified in (Section 11.A.2.1). Container types, preservatives, and volumes will be identified on the chain-of-custody form.

Holding time is the maximum allowable period between sample collection and analysis. Exceeding holding times could result in changes in constituent concentrations due to volatilization, decomposition, or other chemical alterations. Holding times depend on the constituent and are listed in analytical method compilations such as APHA/AWWA/WEF, *Standard Methods for the Examination of Water and Wastewater*; SW-846; and the EPA-600 Method series (e.g., EPA-600/4-79-020). The final status groundwater monitoring plans and this attachment define a sample as a filled sample bottle for purposes of starting the clock for holding time restrictions.

11.B.1.1 Decontamination of Drilling and Sampling Equipment

Drilling of wells is not addressed in final status groundwater monitoring plans. Therefore, a discussion of the decontamination of drilling equipment is not included.

Sampling equipment will be decontaminated in accordance with sampling equipment decontamination methods. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each specific sampling activity.

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Special care should be taken to avoid the following common ways in which cross contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers.
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground).
- Handling bottles or equipment with dirty hands or gloves.
- Improperly decontaminating equipment before sampling or between sampling events.

Decontamination of sampling equipment and pumps is typically performed using high-purity water in each step. Four rinse cycles are performed to decontaminate sampling equipment: detergent rinse, acid rinse, water rinse, and a hexane rinse. During the detergent rinse, equipment is washed in a phosphate-free detergent solution, followed by rinsing with water in three sequential containers. After the third water rinse, equipment that is stainless steel or glass is rinsed in a 1 M nitric acid solution (pH less than 2). Equipment is then rinsed with water in three sequential containers (the water rinses following the acid rinse are conducted in separate water containers that are not used for detergent rinse). Following the final water rinse, equipment is rinsed in hexane and then placed on a rack to dry. Dry equipment is loaded into a drying oven. The oven is set at approximately 50°C (122°F) for items that are not metal or glass or at approximately 100°C (212°F) for metal or glass. Once reaching temperature, equipment is baked for approximately 20 minutes and then cooled. Equipment is then removed from the oven and enclosed in clean, unused aluminum foil using surgical gloves. The wrapped equipment is stored in a custody-locked, controlled access area. Water-level measurement tapes (portion that came in contact with groundwater) are decontaminated using a high-purity water rinse and dried with disposable towels.

To decontaminate sampling pumps that are not permanently installed, the pump cowling is first removed (if needed), washed in phosphate-free detergent solution, and then reinstalled on the pump. The pump is then submerged in phosphate-free detergent solution, and approximately 11.4 L (3 gal) of solution is pumped through the unit and disposed. Detergent solution is then circulated through the submerged pump for about five minutes. The pump is removed from solution and rinsed with water. The pump is submerged in water, and approximately 30.3 L (8 gal) of water is pumped through the unit and disposed. The pump is removed from the water, and the intake and housing are covered with plastic sleeving. Cleaning is documented on a tag that is affixed to the pump with the following information:

- Date of pump cleaning.
- Pump identification.
- Comments (if any).
- Signature of person performing decontamination.

11.B.1.2 Water Levels

For each sampling event, measurement of the groundwater surface elevation at each monitoring well is required by WAC 173-303-645(8)(f). Using a calibrated depth measurement tape, the depth to water is recorded in each well prior to sampling. When two consecutive measurements are taken that agree within 6 mm (0.24 in.), the final determined measurement is recorded, along with the date and time for the specific event. The depth to groundwater is subtracted from the elevation of a reference point (usually the top of the casing) to obtain the water-level elevation. The top of the casing is a known elevation reference point because it has been surveyed to local reference data.

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11.B.2 Documentation of Field Sampling Activities

Logbooks for field sampling activities are identified with a unique project name and number. Only authorized persons may make entries in logbooks. Logbook entries will be reviewed by the sampling FWS, cognizant scientist/engineer, or other responsible manager; the review will be documented with a signature and date. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

Data forms for field sampling activities are also identified with a unique project name and number. Data forms may be used to collect field information; information recorded on data forms is the same as for logbooks. The data forms are referenced in the logbooks.

The following information is recorded in logbooks or on data forms:

- Day and date; time task started; weather conditions; and names, titles, and organizations of personnel performing the task.
- Purpose of visit to the task area.
- Details of field tests that were conducted, and references to forms that were used and methods followed in conducting the activity.
- Details of field calibrations and surveys that were conducted, and references to forms that were used, other data records, and methods followed in conducting the calibrations and surveys.
- Details of samples collected and the preparation (if any) of splits, duplicates, or blanks.
- Time, equipment type, serial or identification number, and methods followed for decontaminations and equipment maintenance performed (reference the page number[s] of any logbook where detailed information is recorded).
- Equipment failures or breakdowns that occurred, with a brief description of replacements.

11.B.3 Calibration of Field Equipment

On-site environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work processes, and/or field instructions that provide direction for equipment calibration or verification of accuracy by analytical methods. Calibration records will include the raw calibration data, identification of the standards used, associated reports, date of analysis, and analyst's name or initials. Results from instrument calibration activities are recorded.

Field instrumentation calibration and QA checks will be performed as follows:

- Prior to initial use of a field analytical measurement system.
- At a minimum, at the frequency recommended by the manufacturer or methods, or as required by regulations.
- Upon failure to meet specified QC criteria.
- Daily calibration checks will be performed and documented for each instrument used (these checks will be made on standard materials sufficiently like the matrix under consideration for direct comparison of data; analysis times will be sufficient to establish detection efficiency and resolution).
- Using standards for calibration that are traceable to a nationally recognized standard agency source or measurement system (manufacturer's recommendations for storage and handling of standards, if any, will be followed).

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11.B.4 Sample Handling

Sample handling and transfer methods preclude loss of identity, damage, deterioration, and loss of sample. Custody seals or custody tape will be used to verify that sample integrity has been maintained during sample transport. The custody seal will be inscribed with the sampler's initials and date. If during the chain-of-custody process it is discovered that the custody tape has been tampered with or broken on the sample bottle, the sample will be analyzed but the results will include a flag to indicate that custody was broken. If the custody tape has been tampered with or broken on the cooler, the sample custodian shall note this on the sample receiving documentation.

A sampling and analytical database is used to track samples from the point of collection through the laboratory analysis and reporting process.

11.B.4.1 Containers

Samples will be collected, where and when appropriate, in break-resistant containers. The field sample collection record will indicate the lot number of the bottles used in sample collection. When commercially precleaned containers are used in the field, the name of the manufacturer, lot identification, and certification will be retained for documentation.

Containers will be capped and stored in an environment that minimizes the possibility of sample container contamination. If contamination of the stored sample containers occurs, measures will be implemented to prevent reoccurrences. Contaminated sample containers cannot be used for a sampling event. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. Container types and sample amounts/volumes are identified on the chain-of-custody form.

11.B.4.2 Container Labeling

Each sample is identified by affixing a standardized label or tag to the container. This label or tag will contain the sample identification number. The label will identify or provide reference to associate the sample with the date and time of collection, preservative used (if applicable), analysis requested, and collector's name or initials. Sample labels may be either preprinted or handwritten in indelible or waterproof ink.

11.B.4.3 Sample Custody

Sample custody protocols maintain sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples shipped to any laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility for custody of the sample changes, new and previous custodians will sign the record and note the date and time.

The following minimum information is provided on a completed chain-of-custody form:

- Project name.
- Collectors' names.
- Unique sample number.
- Number of sample containers per unique sample identification number.
- Date, time, and location (or traceable reference thereto) of sample collection.

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- Chain-of-possession information (i.e., signatures and printed names of each individual involved in the transfer of sample custody and storage locations, and dates/times of receipt and relinquishment).

Additionally, the following information may be included on the chain-of-custody form:

- Matrix.
- Preservatives.
- Requested analyses (or reference thereto).
- Shipped-to information (i.e., analytical laboratory performing the analysis).

Sample custody will be maintained within laboratories in accordance with their documented protocols.

11.B.4.4 Sample Transportation

Packaging and transportation instructions will comply with applicable transportation regulations and DOE requirements. Regulations for classifying, describing, packaging, marking, labeling, and transporting hazardous materials, hazardous substances, and hazardous wastes are enforced by the U.S. Department of Transportation (DOT). Carrier-specific requirements, defined in the current edition of International Air Transport Association (IATA) *Dangerous Goods Regulations,* will also be considered when preparing sample shipments conveyed by air freight providers.

Samples containing hazardous constituents above regulated amounts will be considered hazardous material in transportation and transported according to DOT and IATA requirements. If the sample material is known or can be identified, then it will be classified, described, packaged, marked, labeled, and shipped according to the specific instructions for that material.

11.B.5 Management of Waste

Waste materials generated during sample activities, including purgewater and decontamination fluids, will be collected and managed in accordance with CERCLA as authorized under the *Tri-Party Agreement Action Plan* (Ecology et al., 1989b) Milestone M-024, and the waste control plan or waste management plan associated with the applicable groundwater operable unit. Purgewater management is provided in Permit Attachment 10 of the Site-wide Permit, *Strategy for Handling and Disposing of Purgewater at the Hanford Site*.

For waste designation purposes, data from wells included in the network for a given DWMU (as provided in the associated monitoring plan) may be surveyed in the HEIS, and the maximum concentration for each analyte within the most recent 5 years will be evaluated for use in creating a waste profile, if necessary.

Packaging and labeling during waste storage and transportation will meet WAC 173-303, DOE, and DOT requirements, as appropriate.

Offsite analytical laboratories are responsible for the disposal of unused sample quantities and wastes generated during analytical processes.

11.C REFERENCES

40 CFR 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants*, Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit—Revision 2" Code of Federal Regulations. Available at: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-136.

APHA/AWWA/WEF, 2022, *Standard Methods for the Examination of Water and Wastewater*, 24th Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

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Atomic Energy Act of 1954, as amended, 42 USC 2011, Pub. L. 83-703, 68 Stat. 919. Available at: https://www.energy.gov/sites/prod/files/2017/10/f38/Atomic%20Energy%20Act%20of%201954%20%28AEA%29%20in%20U.S.C..pdf.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: https://www.csu.edu/cerc/researchreports/documents/CERCLASummary1980.pdf.

DOE/RL-96-68, 2022, *Hanford Analytical Services Quality Assurance Requirements Document*, Rev. 5, *Volume 1: Administrative Requirements*; *Volume 2: Sampling Technical Requirements*; *Volume 3: Field Analytical Technical Requirements*; and *Volume 4: Laboratory Technical Requirements*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:

https://pdw.hanford.gov/document/AR-21345.

https://pdw.hanford.gov/document/AR-21348.

https://pdw.hanford.gov/document/AR-21349.

https://pdw.hanford.gov/document/AR-21350.

Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=82.

EPA/240/B-01/003, 2001, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2016-06/documents/r5-final_0.pdf.

EPA/240/R-02/004, 2002, *Guidance on Environmental Data Verification and Data Validation*, EPA QA/G-8, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/default/files/2015-06/documents/g8-final.pdf.

EPA 540-R-20-005, 2020, *National Functional Guidelines for Organic Superfund Methods Data Review*, Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, DC. Available at: https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_organic_superfund_methods_data_review_november_2020.pdf.

EPA 542-R-20-006, 2020, *National Functional Guidelines for Inorganic Superfund Methods Data Review*, Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, DC. Available at: https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_inorganic_superfund_methods_data_review_november_2020.pdf.

EPA-600/4-79-020, 1983, *Methods for Chemical Analysis of Water and Wastes*, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://pdw.hanford.gov/document/D196019611.

EPA/600/R-93/100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, Office of Research and Development, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=30002U3P.txt.

DRAFT

IATA, *Dangerous Goods Regulations*, current edition, International Air Transport Association, Montreal, Quebec, Canada.

OSWER Directive 9200.1-85, 2009, *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use*, EPA 540-R-08-005, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1002WWF.TXT.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: https://www.govinfo.gov/content/pkg/STATUTE-90/pdf/STATUTE-90-Pg2795.pdf.

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/hw-sw846/sw-846-compendium.

WA7890008967, Hanford Facility Dangerous Waste Permit (Site-wide Permit), Revision 9A, as amended, Washington State Department of Ecology.

WAC 173-303, *Dangerous Waste Regulations*, Washington Administrative Code, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-303.

303-645, *Releases from regulated units*.

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